arsenic. Price showed quantitatively that honey-bees are quite susceptible to arsenic poisoning, and, therefore, it would be unwise to run the risk of killing bees by spraying trees in blossom. Richardson has done promising quantitative work on nicotine substitutes. The writer will offer quantitative proof for conclusions on some practical matters in arsenical practice. He intends to show that acquired individual tolerance to arsenic is very unlikely; that, on a unit weight of larva basis, young larvae are less resistant to arsenic poisoning than older larvae; that different species of insects may vary decidedly in resistance to equal doses of arsenic on a unit weight of insect basis, and that trivalent arsenic is more toxic than pentavalent arsenic.

In general, insect toxicology may be expected to analyze the complications of insecticide practice, and so help to explain failures and suggest improvements in field materials and methods. However, immediate practical results should neither be desired nor expected from every investigation in insect toxicology, since the more fundamental branches of science have invariably profited by an unlimited range of inquiry.

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THE REQUIREMENT OF MATHEMATICS FOR COLLEGE FRESHMEN

NEXT to freshman "English," a year of mathematics is doubtless the most universal requirement in our colleges. Such preeminence requires unusual justification. Broadly speaking, mathematics serves two purposes: it is a tool for the solution of certain immediate problems, and it is an instrument for thought. Too few students ever attain the perfection of skill in technical manipulations to enable them to use mathematics in solving real—as contrasted with classroom—problems. If we are to justify requiring mathematics of every one or virtually every one, we must turn to the second purpose.

Mathematics is still justified as a formal discipline. It is considered to be fine training in accurate thinking. But the doctrine of formal discipline has undergone a good deal of modification under the buffeting of experimental study. We know, for instance, that no amount of purely formal or repetitive drill in accuracy will increase one's accuracy in general. To base the requirement of mathematics upon purely formal discipline is to play into the hands of the enemy.

Yet mathematics can be made a real training for thought. Clear, accurate and rapid thought depends largely upon the mastery of certain concepts, many or most of which are essentially mathematical in nature. To name but a few, how can one think clearly about certain problems without a grasp of the concepts of asymptotic approach to a limit, of maxima and minima, of independent and dependent variability and of functional relationship? Certainly one can attain to practical mastery of these concepts in circumscribed fields without the mathematical approach, but the surest route is surely through mathematics.

Is this to emphasize the obvious? Certainly, for mathematicians. But not for students. Mathematics has not succeeded in justifying itself to the student on these grounds.

More important, the point, however obvious, does not seem to have influenced the teaching of early courses in mathematics, either in secondary school or college. It is sound pedagogical principle to isolate for emphasis those factors in a study which are of greatest importance and which should form part of the permanent equipment of the student. Thus when the concept of functional relationship has been taught by means of specific instances, of problems to be solved according to a mathematical technique, the student should be led to *generalize* this concept as much as possible. Otherwise there is the gravest risk —rather the positive certainty—that it will remain a mere technical device for solving certain equations in "Math I." Yet how often is the notion of functional relationship correlated with Mill's so-called canons of induction in such a way that the student may see that this thing with which he has been dealing by means of abstract symbols is basic to all thought about cause and effect?

I therefore venture to suggest that an effort be made to list the fundamental concepts of mathematics which form the basis of clear, factual thinking. And that teachers of mathematics bend every effort to get the student to grasp the *universal* significance and applicability of these concepts. I can not believe that required mathematics will lose in popularity for this; nor does it seem that it will lose in effectiveness even in the teaching of technical manipulations. In any case, those who need the latter—engineers and physicists and so on—not less than others need to know the fundamental significance of their tools.

I am more uncertain about the second suggestion I have to offer. Great progress has been made in recent years in including certain statistical notions in freshman courses, but these courses are still oriented primarily towards mechanics. Now great as have been and probably will be the contributions of physical science to civilization, it has become a commonplace that the future of mankind for the next two or three centuries will depend less upon the con-

tributions of physical science than upon the machinery for their social control. That is, our future depends upon the extent to which in psychology and the social sciences fact is substituted for opinion and the insight of genius or expert. And fact in these fields means statistics. Fortunately the mathematical demands of statistical fundamentals is not so severe as would be inferred from the rather horrendous formulae.

We shall be told, of course, that the time is already taken up with absolute essentials; it always is in every course. But if the foregoing analysis is correct, these "essentials" are less important than some aspects now slighted. One realizes, of course, that the concepts for which we ask more attention are difficult to teach to students without knowledge of rudimentary mathematical operations. Drill in manipulations is essential; but how much? What I am pleading for is a slight shift in orientation. Once the objective is clearly defined, we are ready for a fresh attack on the problem of the irreducible minimum of drill in the manipulation of symbols. We are ready, also, on the side of content, to face the question whether it is more important to teach the student the sort of operations necessary to solve problems in mechanics and thermodynamics, which only a few of them will ever attempt to do, or the sort of operations necessary to solve the problems of citizenship, which ought to be the concern of all.

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SCIENTIFIC BOOKS

The Old Americans. By A. HRDLIČKA. Baltimore, Williams and Wilkins Company, 1925.

THE able curator of physical anthropology of the National Museum has for many years been making measurements and observations on the physical traits of men, women and children who are descendants through a number of generations on both sides of the early immigrants to this country. These early immigrants were less varied than those of the last few decades, being chiefly from the British Isles, with some admixture of Spanish, Dutch and Swedes and later some Germans. The elements were varied enough, however, to comprise, on the one hand, the tall, long-headed, light-pigmented northerners and the stocky, round-headed, deeply-pigmented peoples of the south of Europe. The immigrants were selected for sturdiness and energy. They came to a new country where conditions permitted of rapid spread, and healthy living, including abundant nutrition. The people of different European nationalities here intermarried and from this blend has gradually arisen a new type which Hrdlička calls the "Old American." To define this type it has been necessary to make extensive measurements for comparison with the natives of the different countries of Europe.

In his study Dr. Hrdlička examined over 900 subjects in detail and 1,000 additional, more superficially as to pigmentation, etc. The material is homogeneous in that old persons and children are not considered and the majority is drawn from the social middle class, excluding laborers or servants. A great many clerks and professional people are included. In the book there is first considered the pigmentation of the old Americans, including the color of the skin, hair and eyes. Under measurements are included tables and distribution curves on stature, weight, sitting height, chest, arms, hand, leg, foot, head and facial features. Physiological observations on pulse, respiration, temperature and muscular strength are considered. Finally the results of the study are given in a series of abstracts and a picture is drawn of the future American type. In the last chapter the reassuring conclusion is drawn that the new American "will in all probability be, in the average, tall, more sanguine, and perhaps less spare than the old. It will remain an intermediary white type in pigmentation, head form and other respects. It will show for a long time a wide range of individual variation in all respects. And it may well be expected to be a wholesome and effective type, for mixtures such as those from which it shall have resulted are, so far as scientific research shows, not harmful but rather beneficial, and conditions of life as well as environment in this country are still propitious."

The method of treatment of the subject matter makes this book more than a study of a group of persons. It is, on the one hand, a sort of text-book of anthropometry; on the other, it gives a comparative view of physical traits throughout the world while it lays especial stress upon the condition of the adult in the United States as a whole and in the separate sections of the country. For example, under "arms" we have a statement concerning the significance of this measurement, a description of the different methods of measuring arm length, a table of frequencies of the different absolute measurements of arm length in males and in females, together with frequency polygons of these results. There is a comparison of the youngest and oldest of the group in respect to arm length, a consideration of arm length in relation to stature and in relation to type of head. There is a table, two pages long, giving relative span in various groups of mankind for both sexes and, finally, there is a summary of the results, as far as old Americans go, with a brief comparison of the